Savannah River Technology Center
Baseline Report

U.S. Department of Energy
Office of Environmental Management
Office of Science and Technology

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Executive Summary

The purpose of this document is to provide an overview of the Savannah River Technology Center (SRTC) and summarize its current status to provide U.S. Department of Energy's (DOE) Office of Environmental Management (EM) with a baseline of the center's structure, management, and activities. Section 1 of this report discusses SRTC's mission, organization, capabilities, and customers. Section 2 provides a status report of SRTC's management, operations, and infrastructure based on existing documentation and a site visit. The appendices contain expanded information on particular aspects of SRTC's management, facilities, and operations.

Overview

SRTC is an applied research and development (R&D) laboratory at the DOE Savannah River Site (SRS). SRTC supports the national defense through its technologies and capabilities in the processing, handling, and storage of tritium and plutonium; environmental management; and non-proliferation activities. SRTC works in partnership with SRS's operating divisions, as well as other government, academic, and private research organizations. In recent years, SRTC's role has expanded to provide related support to other DOE organizations, federal agencies, and private industry.

SRTC's mission is:

"To lead in the development of unique, integrated science and technology solutions and opportunities that maximize value and enable the current and future success of our customers."

To accomplish this mission, SRTC has developed expertise in nine core business segments:

Environmental Remediation: Develop methods to detect contamination in soils, groundwater, and wetlands and to eliminate or contain pollutants.
Material Stabilization: Convert nuclear materials to more stable forms for long-term storage and disposal. Integrate waste characterization, glass and ceramic formulations, process design, modeling, pilot-scale testing, product qualification, and field support.
Waste Processing Technology: Develop and apply technologies for treatment of various wastes, such as high-level and low-level radioactive wastes, mixed wastes, transuranic wastes, contaminated asbestos, ion exchange resins, and medical wastes.
Hydrogen and Tritium Technology: Develop and implement hydrogen isotope processing and storage technology to support SRS tritium operations, DOE Weapons Design Laboratories, and offsite customers consistent with DOE directives.
Sensor Technology: Develop sensor systems for remote, real-time analysis of online chemical processes.
Remote Systems and Robotics: Develop remote systems utilizing commercially available robotics equipment to minimize personnel exposure to ionizing radiation and hazardous chemicals.
Nonproliferation Technology: Maintain and continue to expand capabilities for environmental hydrologic and atmospheric monitoring, high-sensitivity radiation detection and mapping, and remote multispectral sensing and imaging.

Actinide Processing: Develop flowsheets for dissolution, separation, purification, and stabilization of the actinide elements. Assist in development of the chemistry baseline for operational safety of actinide processing facilities.
Aluminum Reactor Fuel: Develop and advance the expertise in interim storage, surveillance, transportation, and disposal technologies for aluminum-based spent nuclear fuel.

SRTC has approximately 750 scientists, engineers and support staff who develop and apply technologies to solve problems across the DOE complex. SRTC was originally designed as a support laboratory to SRS and its main customer continues to be SRS. However, over the last decade, the center has expanded its customer base to include private industry, other DOE organizations, and other government agencies such as the Departments of Defense, Transportation, and Justice; and the Nuclear Regulatory Commission (NRC). SRTC partners with many of these same entities and academia to extend its R&D capabilities. The increased customer base also enables SRTC to maintain core competencies necessary to support the DOE mission.

SRTC's funding for FY98 was $114 million and for FY99 was $126 million. Funding is expected to increase slightly over the next five years as a result of new mission opportunities at the site, as well as an increase in work for external (non-SRS) customers projects.

Status
SRTC's organization is well aligned to its mission and business goals. It is clear that reengineering has been applied to the organization and SRTC appears to have incorporated many of the most desirable attributes of a privately held R&D facility.

In order to support SRS, as well as provide expertise to other programs across the complex, SRTC must continue to foster its reputation for technically innovative and cost-effective solutions. At the same time, the center must maintain its strategic focus and strive to be the best in R&D. As stated in its Strategic Plan, SRTC capitalizes on a broad range of opportunities to make major contributions both to new Site missions and to the delivery of solutions to ongoing operational problems. SRTC must assimilate ongoing SRS budget constraints and changing priorities to maintain core competency through funding diversification and teaming arrangements. The center must focus on cost-effectiveness and cost-reduction; both through continued reengineering of its own business and implementing technology in the center's operating divisions.

Staff should continue to strive for recognition of their individual and team contributions. Their creativity and innovation needs to be nurtured through educational, training, and sabbatical programs. SRTC's increased visibility and reputation is dependent on the successes of its workforce, and conversely, the continued recruitment of highly trained, experienced personnel is dependent on that visibility and reputation.

It is essential that SRTC continue to maintain a safe working environment that enables its success. SRTC has an excellent track record in safety. Aging facilities and the deterioration of infrastructure in the laboratory are key and immediate concerns and should be addressed promptly to avoid adverse occurrences. A recent external review recommended the development

of a recovery plan for laboratory infrastructure. However, with limited site funding for infrastructure needs, SRTC continues to experience funding levels far below what is needed to maintain current capabilities.

SRTC has a robust Quality Assurance (QA) program that includes an innovative addition to its QA tools. SRTC recently developed a Conduct of Research Manual establishing a research philosophy and formalizing the methodology for conducting work. The objective of the manual is to achieve excellence in Research and Safety Performance.

In summary, SRTC is successfully progressing from a site-dedicated laboratory to an R&D center that provides technological solutions and technologies to DOE and other organizations. The center needs to continue to strike an appropriate balance between site work and external work to ensure its future in maintaining its workforce and fulfilling its mission. With improved facilities and infrastructure, SRTC is fully capable of providing innovative, cost effective technological solutions to national issues.

1 Overview of the Laboratory

1.1 Introduction

The Savannah River Technology Center (SRTC) is an applied R&D laboratory at the Department of Energy's (DOE) Savannah River Site (SRS). SRTC supports the national defense through its technologies and capabilities in tritium and plutonium processing, handling and storage, environmental management, and non-proliferation activities. SRTC works in partnership with SRS's operating divisions, as well as other government, academic, and private research organizations. In recent years, SRTC's role has expanded to provide related R&D to other DOE sites, other federal agencies, and private industry. SRTC qualifies as a Federally Funded Research and Development Center (FFRDC) and requires this authority to continue to conduct research across the complex.

1.1.1 History

SRTC began operations in 1951 as the Savannah River Laboratory (SRL) to provide R&D support for the production of nuclear materials for national defense. Although SRL's main building was not constructed on its present site until 1952, the technical personnel began work when the Savannah River Project was announced.

Before the site startup in 1953, SRL personnel worked mainly on reactor design, chemical processes, and supporting operations. As more was learned about these first-of-a-kind facilities and processes, the laboratory increased research and experimentation efforts to provide guidance and recommendations for improving the designs and operating conditions. Once SRS had fully entered the production mode, SRL's focus increasingly turned to studies of process improvements, alternative processes, and expansion of production capabilities. By 1960, reactor power had increased, new fuel designs had been developed, and separations capabilities were enlarged.

As a result of the broader versatility of the laboratory, experimental programs increased through the 1960's. Most of these programs involved special irradiation and processing, including the production of trans-plutonium isotopes (Am, Cm, and Cf) and U-233, and the processing of offsite fuels. During this time, the laboratory played a vital role in defining the scope and design data for these projects.

Although issues concerning the environment, waste disposal, and reactor safety had always been a consideration, emphasis on these programs grew in the 1970's and 1980's. More of the laboratory's resources were devoted to the monitoring and reduction of radiation doses in both on- and off-site environments. Studies in alternative waste forms increased, and the development of the Defense Waste Processing Facility (DWPF) was initiated. The laboratory's normal R&D support for the reactors also increased during this time with the continuous effort to upgrade systems and determine reactor power limits.

As the site's mission changed after the end of the Cold War, the laboratory continued to evolve to meet the needs of SRS operations, DOE, and the nation. Increased emphasis was placed on innovative and cost-effective methods of cleaning up the environment, stabilizing all forms of

waste, and adapting SRL technology to the benefit of industry. As production operations for the most part ceased, R&D efforts in decontaminating and decommissioning grew in importance. The site's tritium activities remained as a major emphasis of the laboratory's applied research.

In 1992, SRL underwent a major organizational change, taking the new name Savannah River Technology Center. An applied R&D laboratory with approximately 750 employees, the laboratory continues to provide R&D to support national defense through its technologies and capabilities in nonproliferation and tritium processing. SRTC also applies new technologies to stabilize and dispose of nuclear materials, clean up groundwater and soils polluted with industrial wastes, and explore alternative energy uses. Its mission includes engaging in partnerships with industry, academia, and government agencies to apply the most cost-effective and efficient solutions to the environmental legacy of the cold war. In 1992, the landlord responsibilities for the laboratory transferred from Defense Programs to the Office of Environmental Management (EM) within DOE.

1.1.2 Mission/Vision

SRTC's mission is:

"To lead in the development of unique, integrated science and technology solutions and opportunities that maximize value and enable the current and future success of our customers."

The SRTC vision is:

"To be recognized as a world class center of excellence for the application of science and technology solutions vital to our customers' success."

1.1.3 Goals/Objectives/Strategies

SRTC's business goals are to provide the technology and support for site missions. These goals are:

Nuclear Material Management and Disposition – become a center for nuclear material management and disposition well into the next century.
High-level Waste – ensure the success of high-level waste activities
Tritium – ensure the success of current and future tritium activities
Environmental Restoration – enable the success of the Environmental Restoration Program through the application of the Technology Engine (Technology Engine is the concept of having a technology center that, in partnership with its customers, identifies technologies that result in cost savings and enhancements)
Solid Waste Programs – enable the success of the Solid Waste Program through application of the Technology Engine
Non-Proliferation Technology and National Security – continue to be a national resource for non-proliferation technology and national security

A careful analysis reveals that several key strategies apply to virtually every goal listed above:

- Through the SRTC Customer Offices, develop Technology Implementation Plans for all Site customers with an emphasis on long-term programs to ensure the viability of Site missions
- Develop partnering agreements with other labs that result in scope documents. These documents will provide clear work definitions for the future
- Maintain positive working relationships with key technology decision-makers to ensure that SRS capabilities are recognized and maximized.

In addition to these key overall strategies, each goal has a set of specific strategies to be implemented to ensure the current and future success of the SRTC mission. These individual goals are enumerated in the 1998 SRTC Strategic Plan (Appendix A), issued in January 1998.

The plan describes SRTC's mission, vision, and core values. It maps core competencies against each of SRTC's business segments and for each segment identifies implementing strategies. The Business Map (Figure 1) is a composite of the current and projected SRTC business picture. It shows the areas of focus for the core technologies, the capabilities that enable the expertise of the core technologies, and finally, the key customers who provide funding. The plan is being updated and the latest version will be released in second quarter FY00.

Core Technology Business Areas	Current and Target Funding Support by Customer				
	SRS	DOE-HQ Office of Science and Technology (OST)	Other DOE Customers (HQ Programs, GOCOs, National Labs, AL)	Federal Agencies	Commercial
Waste Processing	●	●			●
Remote Systems	●	●	●		
Environmental Remediation	●	●	●	●	●
Tritium/Hydrogen	●		●		●
Non-Proliferation Technology and National Security	●		●	●	
Vitrification	●	●	●		●
Instruments and Sensors	●	●	●	●	●
Actinide Processing	●		●		
Aluminum Reactor Fuel	●		●		
Key Enabling Technologies					
Analytical Chemistry	●	●		●	
Computation, Modeling, and Statistics	●	●			
Materials Technologies	●	●	●	●	●
Actual % FY97	57%	15%	22%	3%	3%
Budget % FY00	34%	9%	39%	10%	8%

Figure 1. SRTC Business Map from 1998 SRTC Strategic Plan.

The shaded boxes on the map indicate funding support by customer.

1.2 Organization

The end of the Cold War in 1991 produced almost immediate effects on the mission and workforce of SRTC, along with the rest of the DOE complex. Primarily, the need to refurbish and operate nuclear reactors for tritium production was eliminated, and the focus shifted to disposing of legacy materials and continuing waste management and environmental remediation.

At the same time, the nation's leaders began reducing the federal deficit largely by cutting programs. However, the need to retain a viable workforce and certain critical skills to serve customer needs remained. These factors required significant realignment of the organization.

Figure 2 depicts the current structural organization of SRTC. SRTC has approximately 750 employees, most of whom work in five primary departments.

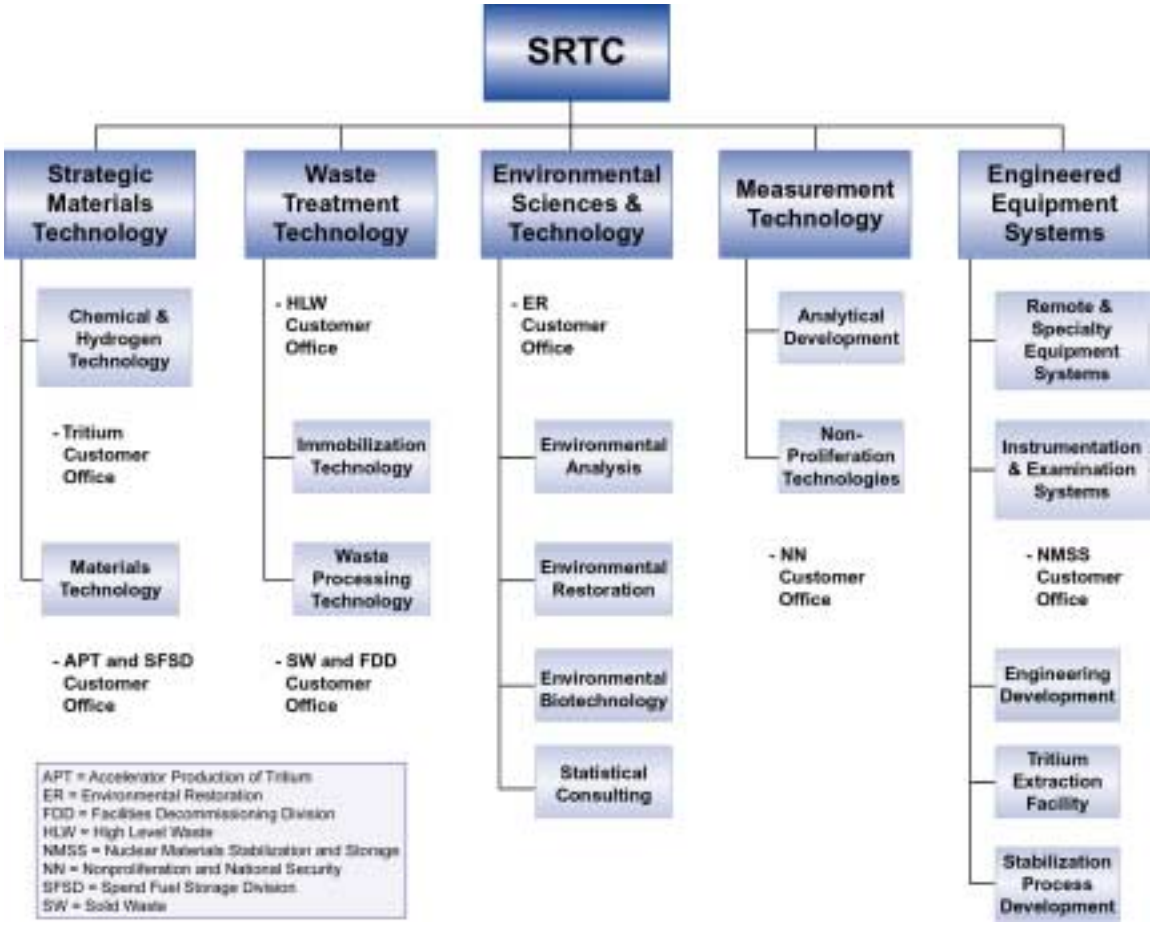


Figure 2. SRTC's Organization.

The Environmental Sciences & Technology Department (ES&TD) solves technical environmental issues and develops and deploys technologies for environmental remediation and compliance programs. Activities include developing new characterization, monitoring, sensing, and remediation (including bioremediation) technologies for site cleanup operations. In addition, the department identifies, demonstrates, and deploys technologies developed by others. Technologies developed and/or deployed by ES&TD are applied at other sites within the DOE complex, as well as by other federal agencies and private industry.

The Measurements Technology Department provides the technology involved with the detection, measurement, and transport of radioactive, hazardous chemical, and thermal emissions from SRS and develops similar technologies for safeguarding special nuclear materials nationally and internationally. The Department also provides analytical capability by means of chemical analysis, material characterization, protocol development, and development of new analyzer technologies.

The Strategic Materials Technology Department provides materials, chemistry, and process support to ongoing site activities, while providing the technology development for securing future site missions. The department supports site programs to prepare residual actinides for stabilization and disposal. It also provides technology and process development R&D for all tritium operations and direct technical support to weapons design agencies upon request. The department is the SRS authority in all materials issues, including assessments of degradation of materials and systems structural integrity, and development of component fabrication technology.

The Waste Treatment Technology Department currently provides the technical basis and R&D for the storage treatment and disposal of all waste at SRS - liquid, solid, hazardous, mixed, transuranic, radioactive, and non-radioactive. The Department has provided technology for the DWPF process (vitrification of high-level radioactive waste).

The Engineered Equipment Systems Department provides engineering and technical support to SRS, including instrumentation, data acquisition, remote handling, robotics, specialized process equipment, non-destructive examination techniques, system integrity evaluations, engineering modeling, experimental thermal-fluids analysis, and radioactive material packaging and transportation.

Support organizations include Quality Assurance, Programs and Administration, and Technology Business Development. Quality Assurance provides independent oversight through a self-assessment program and guides SRTC in the interpretation and application of regulations. Programs and Administration performs administrative and financial planning activities as well as other management functions such as asset management, record keeping, and procurement. The Technology Business Development Department develops opportunities for SRTC to share in advanced technology development programs across the DOE Complex with other federal agencies and in partnership with private enterprises and universities.

1.3 Summary of Major Business Areas

SRTC provides R&D for the Site’s missions, working in partnership with the Site's operating divisions, as well as other government and private research organizations. In recent years, SRTC's role has expanded to provide the following related R&D to SRS as well as other DOE sites, other federal agencies, and other customers:

- environmental remediation
- material stabilization
- waste processing technology
- hydrogen and tritium technology
- sensor technology
- remote systems and robotics

- nonproliferation technology
- actinide processing
- aluminum reactor fuel.

Recently added programmatic activities include R&D support of the proposed Accelerator for the Production of Tritium.

1.3.1 Environmental Remediation

SRTC is assuming a major role in removing or containing pollutants that have found their way into the ecosystem. The center's scientists and engineers are developing methods of detecting contamination in soils, groundwater, and wetlands and are finding the best ways to eliminate these pollutants without further damaging the environment or exposing personnel to potential harm. In a search for more effective solutions, SRS hosted an integrated demonstration of characterization and treatment technologies that could clean groundwater more efficiently. Sponsored by DOE and managed by SRTC, the demonstration combined the Department's national laboratories with private companies and universities to remove trichloroethylene (TCE) and other organic contaminants, commonly used throughout the world as industrial cleaning solvents, from soil and ground water. Several new and cost-effective technologies for environmental cleanup were successfully demonstrated and, in the process, more than 33,000 pounds of solvents were removed. Nearly 50 organizations partnered in the demonstration, and 12 technologies have been commercialized.

SRTC is emerging as a national leader in the use of bioremediation technologies. As part of the integrated demonstration, SRTC scientists used horizontal wells to inject methane (natural gas) mixed with air into a contaminated aquifer. This successful project, resulting in a patent, was the largest and most technically comprehensive full-scale, in-situ bioremediation demonstration ever. In addition, the Department of Energy's first permanent facility designed to use microbes to clean soil contaminated with petroleum products is located at SRTC. Called the "sOILS Facility," the test site offers promise for an effective solution to a worldwide problem.

SRTC recently initiated a program that will develop and apply technologies to identify and remediate dense nonaqueous phase liquids (DNAPLs). The program already has provided the best available information about the extent and nature of DNAPL distribution from a major facility in a field setting.

1.3.2 Material Stabilization

In the last decade, SRTC has developed the capability to characterize waste products and, through testing, specify the appropriate integrated process for any type of waste. With this specialized capability, SRTC has produced more than a million pounds of vitrified waste from a variety of industrial environments.

To support this program, SRTC has developed expertise to precisely analyze any liquid or solid waste product, including noble metals, actinides, and those requiring remote handling, such as radioactive materials. Technology to perform these analyses include:

- inductively coupled plasma atomic emission spectroscopy
- inductively coupled plasma mass spectroscopy
- atomic absorption spectroscopy
- gas chromatography
- ion chromatography
- scanning electron spectroscopy
- transmission electron spectroscopy
- X-ray diffraction.

SRTC, which has studied the behavior of nearly every element in the periodic table in glass, uses a systems approach to glass development. Process models, developed by SRTC, estimate durability and other properties from melter feed ingredients. For more complex problems, the product composition control system, built upon SRTC's proprietary statistical process control algorithm, allows for random variations in the vitrification process. The result is reliable production of a durable glass product, essential in disposing radioactive waste.

1.3.3 Waste Processing Technology

As a producer of plutonium and tritium for nuclear weapons, SRS generated a variety of radioactive, hazardous, and mixed waste. With the advent of new waste disposal standards, SRTC is developing and applying technologies to manage the site's waste issues and apply pollution prevention technologies to reduce future waste. SRTC has contributed its expertise in the design, development, and integration of waste management facilities at SRS. These facilities include:

- *Effluent Treatment Facility* – SRTC evaluated microfiltration, organic removal, ion exchange, reverse osmosis, and evaporation to remove chemical and radioactive contaminants from SRS water
- *Consolidated Incineration Facility* – SRTC integrated systems for treating and reducing the volume of waste generated at the site
- *Saltstone Facility* – SRTC developed and refined the technology for high-level radioactive waste treatment and disposal.

In addition, SRTC capabilities in computer modeling/performance assessment, site characterization, and materials development were applied to the design of solid waste for low-level radioactive waste disposal facilities. SRTC provides the technical basis for safe concentration, storage, transfer, and treatment of high-level radioactive wastes in the tank farm. SRTC evaluates other technologies for waste management, including treatment of hard-to-vitrify transuranic waste containing metals, organics, and salts. The most promising are hybrid plasma vitrification, wet chemical oxidation, and hybrid microwave technology.

1.3.4 Hydrogen and Tritium Technology

Hydrogen expertise has been central to SRS's operations since its inception. Production of tritium began at SRS in the 1950's, in support of national defense. SRTC expertise ranges from molecular and process modeling to handling and processing hydrogen isotopes and compounds. Recent developments using metal hydrides have revolutionized the handling and processing of hydrogen.

Since the first application of hydrides for storing hydrogen was proposed, a number of other applications have followed. The most notable SRS's new Replacement Tritium Facility, the world's largest industrial scale processing system based on metal hydride technology. This facility features the thermal cycling absorption process for isotope separation.

SRTC has leveraged its hydrogen technology capabilities into research of advanced fuel development. Applications for hydrogen energy technology include fuel cells, metal hydride batteries, hydrogen powered vehicles, power generation from fusion energy, and metal hydride air conditioning and refrigeration systems. SRTC is part of a team developing a H_2 Fuel Bus to be operated by the Augusta, Georgia, public transit authority. The bus, designed with a hydrogen fueled, hybrid system internal combustion engine connected to an electric drive train, is expected to operate with twice the range of a comparable electric bus. It will produce near-zero air emissions.

1.3.5 Sensor Technology

In order to minimize risk to workers, the public, and the environment, SRTC-developed capabilities in monitoring and sensor technologies. SRTC-developed monitoring systems provide timely information needed for efficient chemical processing of radioactive material without endangering workers. In addition, sensor technologies monitor the environment and ensure the integrity of equipment containing hazardous and radioactive materials.

In conjunction with sensor technology, SRTC has developed a program in chemometrics. Chemometrics are mathematical models based on measured spectra of a chemical substance. The models are developed from standards that are compared to the sample's spectral data to assess chemical concentration. Chemometrics translate spectral data into useful information for industrial processes or environmental situations. SRTC developed chemometric models for numerous chemical compounds in various forms and solutions.

SRTC has a history of providing rugged, field-tested instrumentation for terrestrial, aquatic, and atmospheric sampling. These instruments are designed for emergency response, radionuclide and chemical contamination measurements, aerial radiation surveys, effluent characterization, and radioactive plume measurements.

SRTC engineers are applying leading edge, commercially available, non-destructive examination technology to ensure the integrity of pipes, vessels, and structures. These techniques include digital radiography, ultrasonics, and a variety of leak testing methods.

With SRTC's expertise in sensor applications, future opportunities can provide real-time chemical monitoring and analysis. For example, SRTC sensor systems could be used at chemical weapons destruction sites to verify treaty compliance. In industry, fiber optic sensor systems promise to simplify chemical accountability, making it much easier and less expensive to comply with environmental regulations on storage of hazardous chemicals.

1.3.6 Remote Systems and Robotics

SRTC is a recognized leader in applied remote systems for radioactive and hazardous environments. SRTC engineers have developed robotics applications for DOE facilities such as

Oak Ridge National Laboratory (ORNL), Hanford Site, West Valley Demonstration Project, Waste Isolation Pilot Plant (WIPP), and Fernald Environmental Management Project (FEMP).

SRTC led many DOE robotics programs, including the Office of Science and Technology's (OST) robotics program for mixed waste operations. As part of this program, SRTC coordinated a national robotics development project for inspection, characterization, handling, and treatment of mixed waste.

SRTC robotics and remote systems expertise crosses six areas, including mobile robots and mobile teleoperators; pipe crawlers and wall crawlers; robotic delivery of non-destructive examination devices to remote areas; robotic manipulation of tools and materials; remote viewing systems; and specialty equipment systems. These systems are operated by radio or cable controls from a remote location or by programming a robot to operate autonomously. These systems hold great potential for increased environmental protection and industrial safety.

1.3.7 Nonproliferation Technology

SRTC is applying its expertise in tritium and plutonium to support DOE's nonproliferation missions. As mentioned above, the center has developed and applied unique processes for storage, separation, and purification of tritium for DOE's weapons programs. Based on its unique capabilities, SRTC provides technical support for Non-Nuclear Reconfiguration, Enhanced Surveillance Program, and the Tritium Extraction Facility. The center provides technical services and measurements for the National and International Safeguards Programs for treaty verifications, forensics, export control and other security programs. SRTC supports the Federal Bureau of Investigation (FBI) in nuclear forensic activities.

In support of its defense mission, SRTC developed RADMAPS, a portable RADiation MAPping System for detecting, locating, and characterizing nuclear materials when the presence of such material is not otherwise documented. This versatile, portable field unit records gamma or neutron radiation spectra and records its location using a Global Positioning System (GPS).

1.3.8 Actinide Processing

Expertise in actinide processing has been central to SRS since the start-up of the separations facility. Production of plutonium was the main mission for the separations facility to supply the nuclear weapons program, with recycling of enriched uranium reactor fuel from SRS production reactors. This role was expanded to other actinides, including neptunium, americium, curium and californium. Research with other actinides has also been done at SRTC.

Recent work has centered on the stabilization of legacy actinides, rather than separation and purification. Processing of scrap solids containing plutonium and uranium in SRS canyons, which were designed for reactor targets, has become important for rapid stabilization of legacy actinide materials. SRTC has developed flow sheets to process these legacy actinides without requiring major equipment changes. SRTC developed safety documentation for actinide residues in new shipping containers, because of hydrogen generation issues with actinides (from moisture in residues).

Processing of Pu-238 for the space program continues and SRTC supported purification of the Russian Pu-238 for the Cassini space shot. SRTC provides R&D support for transuranic (TRU) waste alternatives for Pu-238 waste, because of curie limits for storage at WIPP and hydrogen generation issues with transportation.

In cooperation with the national laboratories, SRTC is producing samples of a plutonium/ceramic material that is being developed for geologic disposal of excess plutonium. This program is being leveraged with university participation with surrogate materials.

1.3.9 Aluminum Reactor Fuel

SRTC is the recognized DOE complex leader in development and deployment of technologies for interim storage (basin and dry), basin surveillance, transportation, and disposal of aluminum-based spent nuclear fuel. The expertise is being applied to support repatriation and consolidation of aluminum-based research reactor fuel as part of DOE's nonproliferation missions. Applications of the technologies are being used at the Idaho National Engineering and Environmental Laboratory (INEEL) and are under formal consideration for international use through the International Atomic Energy Agency (IAEA).

The Melt-Dilute treatment technology has been developed by SRTC to stabilize and reduce the isotopic enrichment of uranium in aluminum-based fuels to provide a superior disposal form. This treatment technology minimizes proliferation risks and criticality issues with highly enriched research reactor fuels. The process of melt-dilute is flexible and can be extended to treat other nuclear materials for safe, permanent repository disposal.

The containment analysis methodology for aluminum-based fuel with cladding failure greater than pinhole and minor cracks was developed by SRTC in cooperation with the U. S. Nuclear Regulatory Commission (NRC). NRC requires this methodology to be applied for certification of casks to transport failed aluminum fuel. This methodology results in an estimated cost avoidance to the Department of more than $50 million from the current practice of canning the estimated 7% of the foreign research reactor fuel with breached cladding prior to shipping. The methodology can be extended to other metallic-based fuels.

1.4 Core Capabilities/Technologies

SRTC recently initiated a systematic process of defining its core technologies/capabilities and enabling technologies to better support site customers with planning strategies, operational support, and innovative technologies needed to successfully accomplish site missions. A core technology (Figure 3) is defined as a competency at which SRTC excels—one that is backed by a depth of knowledge and expertise, is recognized as world-class by technical peers, and is fundamental to the success of SRTC's customers.

➢ **Waste Processing**	➢ **Non-Proliferation Technology and National Security**
o Liquid effluent and process treatment	o Ultra-low-level radiation detection and analysis
o Solid waste processing including decontainerization, containment, and encapsulation	o Ultra-low-level radionuclide analysis o Classified programs o Environmental monitoring
o Modeling and process evaluation	
o Waste packaging design and certification	
o Radioactive material storage technology	
➢ **Remote Systems**	➢ **Vitrification**
o Mobile robots	o Custom glass formulation
o Vision systems	o Actinide chemistry and processing
o Customer remote tooling and sensors	o Analytical chemistry
o Pipe/wall crawlers	o Off-gas system design
o Special engineered equipment systems	o Integrated vitrification systems
➢ **Environmental Remediation**	➢ **Instruments and Sensors**
o Environmental biotechnology	o Fiber optic spectroscopy
o Groundwater remediation systems o Treatment and stabilization of secondary wastes	o High sensitivity analytical instruments and sensors
o Risk-based ecological remediation o Field screening and technology demonstrations	o High-resolution non-destructive imaging using ultrasonic and digital radiography (NDE)
o Special sensors	o Coulometry/Calorimetry/Density (NDA)
	o Advanced instrument system integration and packaging
➢ **Tritium/Hydrogen**	➢ **Actinide Processing**
o Hydride systems	➢ **Aluminum Reactor Fuel**
o Tritium/hydrogen processing	o Corrosion
o Molecular and process modeling	o Tritium effects
o Tritium effects on materials	o Welding/joining
o packaging and transport technology	o Failure analysis

Figure 3. Core Technologies.

In addition to core technologies, enabling technologies are more specific capabilities that support the broader core technologies. SRTC's key enabling technologies are:

- analytical chemistry
- computation, modeling, and statistics
- materials technologies.

These capabilities provide essential crosscutting support for several core technology business areas, but do not necessarily have end customers or support unique end-product research. If work in the related core competency business areas ends, the enabling technologies would no longer have any application and would therefore cease to exist.

1.5 Customers/Funding Sources

In the past, SRTC has focused on providing support to SRS missions. As the nation's priorities have changed, the emphasis at SRS has shifted from strictly weapon production related activities to include environmental cleanup and remediation. As such, SRTC has expanded its capabilities to meet its customer's needs in environmental quality. Figure 4 shows a comparison of funding profiles from FY93 and FY98 indicating this evolution of customer support.

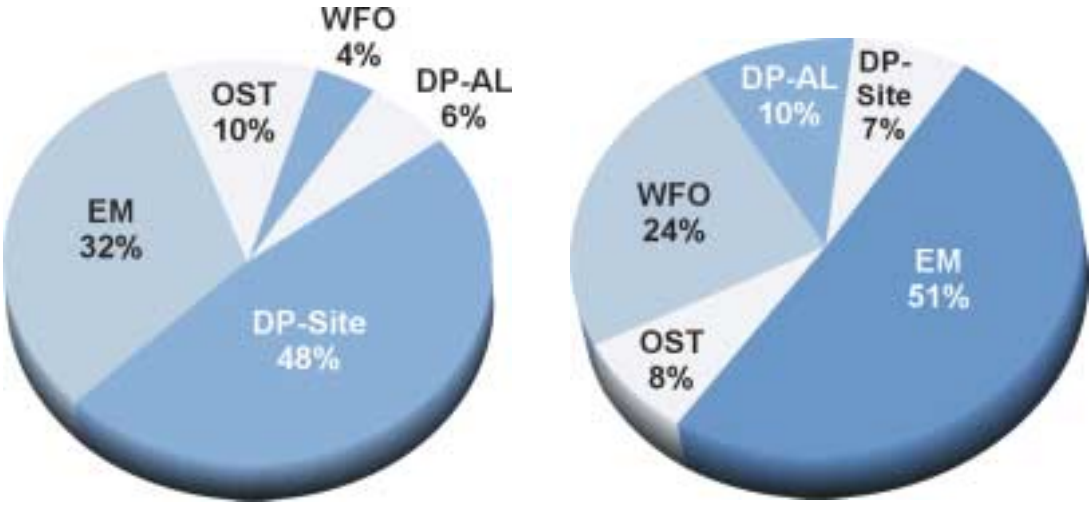


Figure 4. SRTC Funding Comparison FY93 Actual Versus FY98 Actual.

In addition to the SRS programs/projects, SRTC's customers now include:

- DOE Headquarters (HQ), Office of Science and Technology (OST)
- other DOE organizations (Office of Defense Programs [DP], Office of Fissile Materials Disposition [MD], GOCOs, national laboratories, Albuquerque Operations Office [AL], Office of Non-Proliferation and National Security [NN])
- other federal agencies (NRC, U.S. Army, Environmental Protection Agency [EPA], FBI, National Aeronautics and Space Administration [NASA])
- commercial (British Nuclear Fuels Limited [BNFL]).

Lead Lab

For OST, SRTC was named the Lead Laboratory for the Subsurface Contaminants Focus Area (SCFA) in June 1999. Shown conceptually in Figure 5, the Lead Laboratory is managed by SRTC and will be a virtual laboratory comprising technical experts from national laboratories indicated in the figure. The technical base will be augmented, as required, from industry, universities, and other federal agencies. SRTC is responsible for coordinating technical experts, setting priorities, and assuring successful completion of the tasks required of the Lead Laboratory. The Lead Laboratory will work closely with SCFA to assure its requirements for

technical expertise are satisfied in planning, technical assistance, scientific and engineering reviews and in depth evaluations of potential new approaches.

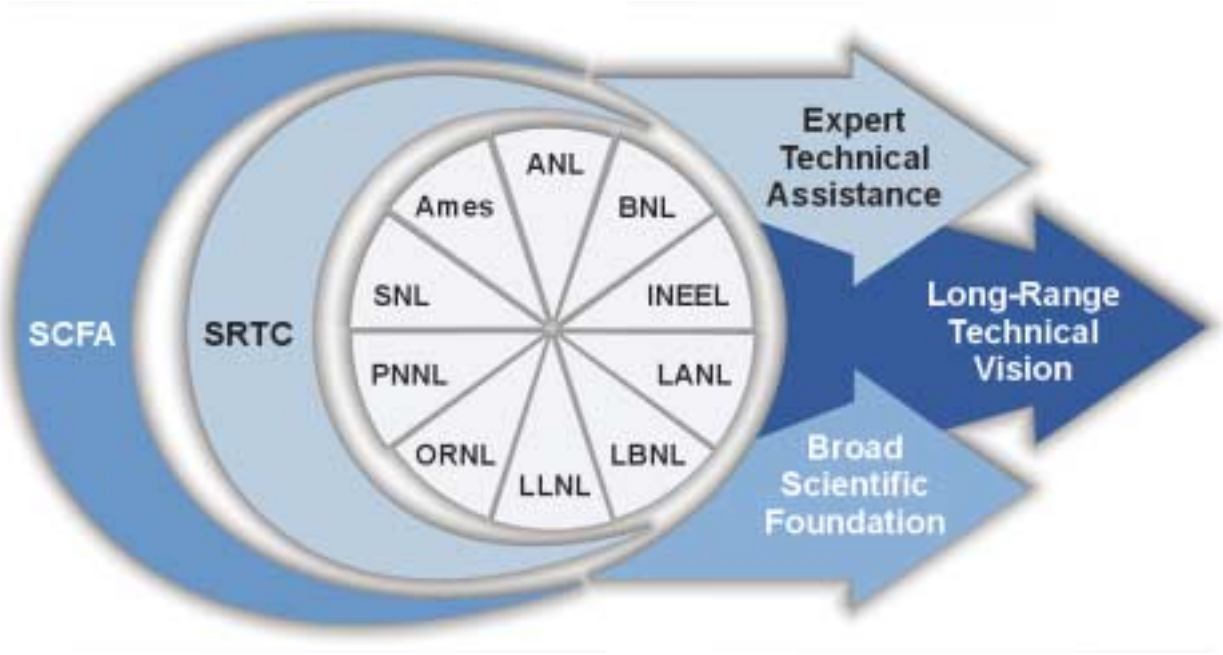


Figure 5. Lead Laboratory Concept as Implemented by SRTC.

1.6 Facilities

The Upper 700-Area of SRS is the central location of SRTC facilities. Many of the laboratories in the main Technical Area are one-of-a-kind design and unique in their capabilities. The facilities in this area include:

- Weather Center
- Underground Counting Facility
- Ultra Low Level Counting Facility
- Savannah River Standards Laboratory (SRSL)
- Chemistry and Analytical Laboratories
- Glovebox Facilities and Intermediate Cells
- Shielded Cells
- Robotics Laboratory
- Thermal Fluids Laboratory
- Glass Shop
- Scientific Computing Resource Center (SRSC)
- Technical Library.

The Lower 700-A Area is in close proximity to the main technical building and is the location where much of the engineering, construction, and materials fabrication are done. Facilities in this area include:

- Electronics Fabrication Shops
- Engineering Facilities

- Metallographic Facilities.

The Tracking Radioactive Atmospheric Contaminants (TRAC) Vehicle is a mobile radionuclide monitoring laboratory that uses state-of-the-art equipment and has the capability to measure and identify all forms of radioactivity in air, water, and soil samples. Monitoring techniques can discriminate between man-made and naturally occurring isotopes. While the TRAC Vehicle is in motion, instruments can detect radioactivity in the atmosphere, on the ground, and in the general area at environmental levels. Besides monitoring the environment, the vehicle supports the Emergency Response Organization at SRS by helping assess impact and tracking migration of radioactivity onsite and in surrounding communities.

Field facilities, capitalizing on unique site resources, augment the two primary SRTC facilities. These include:

- PAR Pond Environmental Laboratory
- Integrated Demonstration Site in M-Area.

The TNX Facility, operated by the Westinghouse Savannah River Company (WSRC) Site Services Division, is dedicated to applied R&D programs onsite. Among other projects, TNX has been the R&D site for the high-level waste glass vitrification process. Although TNX has space and capability for full-size construction and testing of pilot facilities for site missions, the facility is currently inactive.

1.7 Summary of Significant Accomplishments

SRTC continues to deliver solutions to ongoing operational problems and make major contributions to new site missions. Listed below are examples of SRTC's achievements by business line over the last three years.

Environmental Remediation

- R&D 100 Award for SRTC-developed bioremediation technique that stimulates microbes to degrade chlorinated solvents in soils and ground water
- Constructed the sOILS Facility, the first DOE permanent facility designed to use microbes to clean soil contaminated with petroleum products
- 1996 National Federal Laboratory Consortium Award for Excellence in Technology Transfer for developing and encouraging widespread use of bioremediation methods to clean up groundwater and soils contaminated by industrial solvents and petroleum products
- Developed and demonstrated GeoSiphon, a system to passively induce contaminated groundwater flow through an in-situ permeable treatment media at an accelerated rate by using the natural head difference between two points.

Material Stabilization

- Developed and demonstrated the vitrification process used in the DWPF to convert frit and high-level waste to durable glass inside a stainless steel canister
- Developed the Can-In-Canister process to stabilize surplus plutonium in DWPF canisters during production pours

- Developed and deployed a Transportable Vitrification System for onsite remediation, thereby reducing any risks associated with transporting untreated wastes.

Waste Processing Technology

- Awarded $31 million R&D contract for the Hanford Tank Waste Remediation System
- Developed the Saltstone Process, which stabilizes low-level radioactive salt solutions by mixing them with cement, fly ash, and blast furnace slag and then pumping the mixture to a concrete vault to cure
- Developed an industrial partnership to recycle slightly radioactive stainless steel into metal canisters and boxes used for disposal of nuclear wastes.

Hydrogen Technology

- Invented the Thermal Cycling Absorption Process, which separates hydrogen isotopes safely, efficiently, and cost-effectively using hydride technology
- In conjunction with an industrial partner, developing a prototype public transport vehicle using hydrogen as the fuel
- Valuable resource to and participant in the international effort to develop an experimental fusion reactor (International Thermonuclear Experimental Reactor)
- Accomplished essential demonstrations of new tritium storage concepts.

Sensor Technology

- Developed an R&D 100 Award-winning optical temperature sensor system that measures temperatures from -200 °C to 600 °C safely and accurately, even in extremely hazardous, corrosive, and high electromagnetic field environments. Deployed this system in an industrial partner's plant to continuously monitor a critical chemical reaction.

Remote Systems and Robotics

- Developed the Mobile Automated Characterization System, which independently navigates and monitors facilities for radioactive contamination
- Developed a remote magnetic-wheeled wall crawler that ultrasonically inspects waste storage tanks for pitting and corrosion
- Developed a pipe crawler to navigate contaminated ventilation piping and remove an elbow by cutting from the inside
- Developed numerous remote video systems, including a camera system that must fit through a 4-inch diameter riser pipe for the inspection of waste storage tanks
- Developed and deployed a bagless transfer system suitable for the long-term storage of plutonium waste. Transferred this technology to the Hanford site for deployment
- Appointed as DOE product line manager for Robotic and Intelligent Machines (RIM) applications to the SCFA.

Nonproliferation Technology

- Developed RADMAPS, a portable RADiation MAPping System for detecting, locating, and characterizing nuclear materials when the presence of such material is not otherwise documented. This versatile, portable field unit records gamma or neutron radiation spectra and records its location using a Global Positioning System
- Built and tested a small, portable, prototype electrostatic precipitator collector to collect atmospheric particles that can provide significant information about the processes that formed the material and can help identify nuclear proliferation activities.

Actinide Processing

- Developed flow sheets for canyon stabilization of sand, slag and crucible residues
- Supported start-ups and double contingency safety analysis of H-Canyon
- Developed flow sheets for purification and blend-down of highly enriched uranium (HEU) solutions for commercial sale
- Developed baseline safety documentation for hydroxylamine nitrate (HAN)/nitric acid to allow continued use in the Separations Facilities
- Hosted the 21st Annual Actinide Separations Conference, with presentations from four national labs, France, and the United Kingdom. SRTC has three Seaborg Award winners from this conference for outstanding contribution in actinide separations science.

Aluminum Fuel

- Developed the Melt-Dilute treatment process for repository disposal of aluminum-based fuels. The melt-dilute treatment is used to stabilize and reduce enrichment of these fuels to minimize proliferation and criticality issues
- Developed the containment analysis methodology for transportation of failed-cladding, aluminum-based fuel. NRC endorsed this methodology and it is being successfully applied to certify casks to safely transport this fuel
- Developed the technical basis to enable water basin storage of aluminum-based fuel with exposed fuel meat
- Developed acceptance criteria to enable safe, dry storage of aluminum-based fuels for up to 40+ years storage. The acceptance criteria are applied across the DOE complex.

2 Status Report

2.1 Management Oversight

As SRS adjusts to ongoing budget constraints that force readjustment of priorities in its activities, SRTC has to assimilate these changes and work to maintain core competency through funding diversification and teaming. SRTC has focused on cost-effectiveness and cost-reduction, both through reengineering their business processes and implementing technology in the operating divisions. The reengineering process that SRTC implemented has successfully aligned its mission and objectives with its core competencies resulting in an organized structure with clear goals and objectives. Consequently, SRTC is a good example of how a properly aligned structure can facilitate effective program management.

SRTC qualifies as an FFRDC per the criteria established in Federal Acquisition Regulation 35.017 and requires this authority to continue to conduct business effectively DOE wide. SRTC is an integral, key multi-purpose, DOE R&D laboratory and uses its FFRDC status to effectively support the DOE complex. SRTC will provide unique R&D capabilities in support of vital EM missions to supply innovative remediation and waste management technologies well beyond the year 2010.

2.1.1 Program Management

As with most program management, SRTC activities begin with planning (Figure 6). SRTC is not required to participate in the Department's Institutional Planning Process. The basis of SRTC's planning process is its Strategic Plan (Appendix A). The plan presents SRTC's mission, vision, and core values as the foundation for its business goals. The plan is core-competency based with a business map that connects competencies to key business segments. SRTC has identified goals and implementation strategies to meet each goal. The plan enumerates key success factors that will ensure the successful fulfillment of SRTC's mission.

SRTC uses its Strategic Plan as a guide for operational planning. Business Plans are developed for each business segment and provide iterative feedback to the strategic plan for the next year's planning process. Each business plan identifies customers, partners, strategies and tactics, and other issues necessary for successful implementation of goals for that business segment. The plan provides a business niche analysis that evaluates each segment with respect to its:

- depth of competency
- current technologies
- developing technologies
- supporting technologies/niches
- customers and partners
- market assessment
- competition
- infrastructure and capabilities.

Figure 6. SRTC's Strategic Planning Process.

The business plan contains overall business strategies, reviews prior year performance highlights, and discusses intellectual property issues.

Each business segment has a corresponding Business Team that represents the nine core technologies and three enabling technologies. Teams consist of technical management, technologists, and business development support. They are responsible for developing an annual business plan update that forms the basis for budgeting and staff resources. Business Team leaders serve on the Business Council.

The Business Council serves to integrate all of SRTC's business activities to meet strategic plan goals. The Council includes a staff sponsor, business team leaders, business development support, technology transfer support, and customer office representatives. It meets biweekly to review business bookings against the business plan.

SRTC has instituted Customer Service Offices that are responsible for working with the site customer to identify and prioritize technology needs and develop technology plans. The Office matches technical expertise across SRTC to areas with technology problem or needs. Furthermore, the office assists in development of the Annual Operating Plan (AOP) and is responsible for monitoring SRTC's commitments.

SRTC follows the yearly budgeting process to secure its funding. Requests for funding are incorporated into and prioritized along with the site budget request. Once funding has been secured, program implementation is the responsibility of the program manager. The manager

ensures work progresses on schedule and within budget. Technical, financial, and schedule progress is tracked monthly and lessons learned are folded back into the next year's planning process.

2.1.2 Management/Program Reviews

SRTC engages in two comprehensive review processes on a periodic basis:

- External Review - every 18 months
- Facility Evaluation Board Review – annually.

External Review

Over the past several years, SRTC has evolved from an applied R&D center almost completely dedicated to SRS support, to a technology center with almost 50% of its funding originating from a wide range of offsite customers. The complexity of performance assessment for this diverse business portfolio required SRTC institute a formal external review process similar to those in use at multi-program national laboratories.

Using DOE Order 5000.2B as the framework, the External Review Board members are appointed by the SRTC Laboratory Director and are selected from national laboratories, academia, other federal agencies and the private sector. This Board serves to assist in improving delivery of applied R&D services to six customers and assure strategic direction meets future needs.

The External Review provides in-depth evaluations of SRTC's technical business areas using criteria in the following areas:

1. Quality of Science and Engineering:

   Consider subjective and objective indicators of excellence, including impact of scientific and engineering contributions, leadership in the scientific and engineering communities, innovativeness, and sustained achievement. As appropriate, the External Review Board may evaluate other performance measures, such as publications, citations, and awards.

2. Quality of Applied Research and Development Support for the Savannah River Site:

   Consider subjective and objective indicators of excellence including the impact of SRTC programs on the core business needs of site customers; evidence of joint ownership of the flow sheets with operating division; success in transferring the resulting technology to non-site customers; success in bringing in new technologies and approaches from external collaborations and partners; and sustained contribution to successful site operations.

3. Relevance to national needs and agency missions:

   Consider the impact of SRTC R&D on present and future mission needs of SRS, DOE Weapons Complex and other agencies funding the programs. Such considerations include national security, environmental management, and economic competitiveness, as well as goals of DOE and other SRTC funding agencies in advancing applied science. Emphasis

impact on industrial competitiveness and national technology needs. Assess characteristics not easily measured, including relevance of research program to national technology and effectiveness of outreach efforts to industry. As appropriate, the External Review Board may consider such performance measures as licenses and patents, collaborative agreements with industry and the value of commercial spin-offs.

4. Performance in the formal conduct of research activities and operations of SRTC facilities:

   The review should consider the effectiveness of the process for the performance of research including: safety, research planning, readiness of the facility, and support infrastructure. Quantifiable performance measures include safety and radiological control statistics, procedures reviews, facility availability, operations and maintenance budgets, and capital budgets.

5. Programmatic performance and planning of SRTC's applied R&D Mission:

   The review should focus on achievement of broad programmatic goals, including meeting established technical milestones, carrying out work within budget and on schedule, satisfying sponsors, providing cost-effective performance, and planning for orderly completion or continuation of programs. In assessing effectiveness of programmatic and strategic planning, reviewers may consider the ability to execute projects in concert with overall mission objectives, programmatic responsiveness to changes in scope or technical perspective, and strategic responsiveness to new research mission and emerging site and national needs. Evaluation of the effectiveness of programmatic management considerations may include morale, quality of leadership, effectiveness in managing scientific and engineering resources (including effectiveness in mobilizing interdisciplinary teams), effectiveness of organization, and efficiency of facility operations.

An overall rating with recommendations is provided for each unit being reviewed and a confidential formal report is issued to the SRTC Laboratory Director, the Westinghouse Savannah River Company (WSRC) President, and the SRS Manager upon completion of the review.

For the Facility Evaluation Board (FEB) Review, a team of SRS personnel assigned to the FEB conducts a consolidated comprehensive annual review of the organization over a two-week period in over twenty areas including:

- facility organization
- operations
- radiological controls
- engineering
- maintenance
- environmental safety, health, and QA
- training and support.

A formal report is issued to the WSRC President upon completion of the review. The review provides senior management with performance-based information to support continuous

improvement, direct leadership resources, adjust personnel and financial resources, and identify areas of excellence.

In addition to the two major reviews, over 230 audits and self-assessments have been conducted by SRTC over the past fiscal year. Special reviews are performed on an as-needed basis. Examples over the last six years include a core competency assessment, skills requirements study, privatization study, SRTC Reengineering study, Organizational Analysis, and benchmarking study with BNFL.

SRTC is responsible for ensuring its participation in the achievement of SRS's performance based incentives (PBIs). Appendix B discusses SRTC's role in achieving these goals.

2.2 Status of Customers/Funding

2.2.1 Major Customers/Funding

SRTC had an Annual Operating Plan (AOP) of $126 million in FY99. Actual FY99 and projected FY00 funding from SRTC customers are shown in Figure 7. SRTC anticipates an increase in funding from DOE HQ programs from DP and FM that offsets the reduction in funding at the site. The effect of the new BNFL agreement can be seen in the increase in commercial funding.

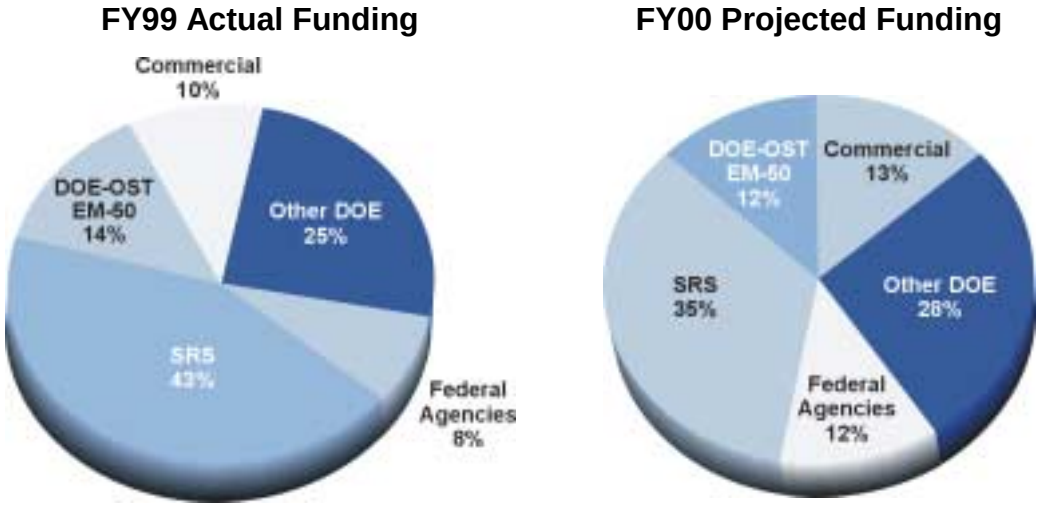


Figure 7. SRTC Funding for FY99 and FY00.

Figure 8 exhibits SRTC's business strategies to increase its support to DOE, other federal agencies, and the private sector. Figure 9 depicts outyear funding projections for SRTC.

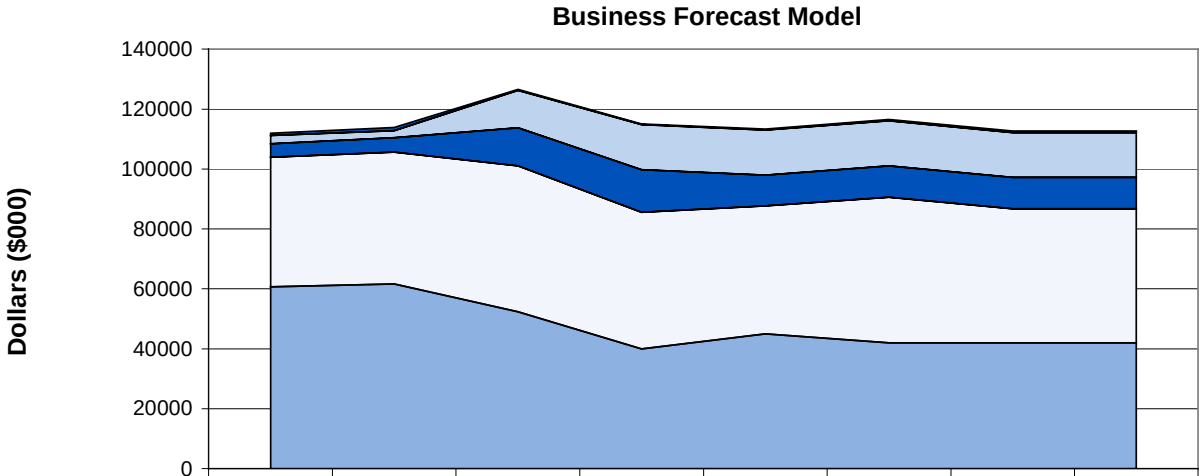
2.2.2 Work for External Customers

SRTC's programs with external customers brought in $52.2 million in FY98 and funding was increased to $68.8 million for FY99. Because of SRTC's performance in providing R&D support to the initial phase of Hanford Tank Waste Remediation, BNFL executed a follow-on agreement. This agreement makes expertise developed for SRS high-level waste activities available to cleanup the Hanford Site and preserves the relevant competencies for SRS and SRTC.

Additionally, agreements are in place with non-traditional clients such as the NRC, the U.S. Army Industrial Operations Command, and EPA. A significant new client is the FBI through a Memorandum of Understanding (MOU) for Science and Technology. SRTC is expected to be a lead in providing nuclear forensics capability to the FBI, a long-term, multi-million dollar effort. Agreements with external customers are managed in accordance with DOE orders with respect to Work for Others. SRS oversees the SRTC work for external customers.

SRS
➢ Be the technology provider of choice to ongoing operations
➢ Support new missions
OST
➢ Continue leadership position in development and deployment of environmental technologies
Other DOE
➢ Strong participation in major HQ programs
➢ Provide SRS technology to other DOE sites
➢ Participate in the Office of Science Programs
Federal Agencies
➢ Build DoD, NASA, and EPA business based on environmental, remediation, waste processing, sensor, and robotics technology
Commercial
➢ Selectively support, provide core technologies
➢ Use commercial partnerships to enter other DOE and Federal agency markets

Figure 8. SRTC's Overall Business Strategies For Future Funding.



	FY97	FY98	FY99	FY00	FY01	FY02	FY03	FY04
Commercial	649	1119	279	300	350	400	450	500
Hanford RPP	2798	2300	12483	15000	15000	15000	15000	15000
Other Federal Agency	4533	4796	12800	14200	10250	10500	10500	10500
Offsite DOE	43188	44027	48642	45600	42700	48600	44700	44700
SRS	60705	61643	52326	40000	45000	42000	42000	42000

Figure 9. SRTC's Business Forecast Model: FY97-FY04.

2.2.3 Strategic R&D Investment

The Strategic R&D Program at SRTC was started in FY98 to develop new technologies consistent with SRS missions. Its overall goal was to allow SRTC to have flexibility for taking a longer range, more strategic view of SRS missions and make recommendations and conduct R&D for new technologies to meet those missions.

Twenty-four projects have been funded by SRS's operating divisions over the two-year period for a total of $4 million ($2 million funding in FY98 and FY99). Projects are proposed by SRTC Principal Investigators based on a needs assessment determined by the operating divisions or by direct discussion with key technical representatives from the operating divisions. A select panel of SRTC senior scientists and engineers review the projects for technical feasibility and make recommendations to a Project Selection Committee. The Committee selects which projects will continue in the case of multi-year projects and authorizes new projects for funding. Projects are limited to three years, although most projects have averaged two-year completions. Even with minimal funding (compared to other programs) the Strategic R&D Program initially has had significant accomplishments. Examples are listed below:

- New formulation for zero bleed grout that reduced the cost of high-level waste tank closure
- Enhanced and more cost-effective techniques for characterizing contaminated concrete
- Promising early result for H_2 pressure reduction in actinide packages
- Development of low temperature frit composition that melts at 1150-1170^{o}C producing homogeneous glass product at 35 wt.% surrogate loading
- Invention disclosure submitted on bithermal membrane process for tritium separation
- Copyrighted software developed for full-image emission spectra resolution with image matching
- Patent disclosure submitted on use of ozone for generation/regeneration of Ag+2 used in separation of plutonium from Rocky Flats incinerator ash.

Future funding for the program is uncertain. Only one million dollars is budgeted for FY00 and the budget may be zeroed out in the outyears. However, initial results indicated the program should continue because of the added value of the work done.

2.2.4 Partnerships and Collaborations

SRTC has been proactive in creating partnerships with industry, academia, and other government agencies. The center uses three principal tools available to foster technological collaboration:

- Work for External Customers
- Cooperative Research and Development Agreements (CRADAs)
- User Facility Deployment Agreements.

Using Work for External Customers, as previously discussed, both private industrial firms and other federal agencies can obtain selected work on a full-cost basis from SRTC. The work must use the site's unique technologies, capabilities, and facilities and must not be in direct competition with private or public sector operations.

Cooperative Research and Development Agreements (CRADAs) result in joint R&D of new technologies that benefit all partners. Each partner provides personnel and equipment to support their portion of the research. Under certain circumstances, private sector partners may fund the site's portion of the work. SRTC partners can be companies, trade associations, state and local government, universities, and non-profit organizations.

SRTC provides access to site facilities for hands-on use by private-sector personnel. Under pre-approved arrangements, industry, academia, and other federal agencies come to the site and use specified expertise, equipment, and facilities. These user facility agreements are done in accordance with departmental policy on scientific user facilities. The Savannah River Operations Office oversees these agreements with the SRTC.

Using these tools, SRTC has partnered with private industry, other government agencies, and nearby community organizations. SRTC supports activities with its regional universities through two nonprofit consortia:

- Education, Research and Development Association of Georgia Universities (ERDA)
- South Carolina Universities Research and Education Foundation (SCUREF).

More than $2 million was provided to these groups in FY99. SRTC collaborates with other universities in Florida, Mississippi, Minnesota, Tennessee, Colorado, and Alabama.

Through Memorandum Purchase Orders (MPOs) and Interdepartmental Work Orders (IDWOs), SRTC has established long-term relationships with other DOE laboratories. Figure 10 shows the scope of SRTC's partnerships with key national and single program laboratories over the past three years. These collaborations have resulted in mutually advantageous research activities that have benefited the Department and transferred technologies to the private sector. In addition, SRTC is participating in the three new mission activities at SRS with other national laboratories:

- Accelerator Production of Tritium (APT) with LANL
- Commercial Light Water Reactor production of tritium with PNNL
- Plutonium Immobilization with LLNL.

➢ LANL	➢ Sandia
➢ Accelerator Production of Tritium	➢ Technology Demonstrations/Deployments
➢ Tritium Weapons R&D and Surveillance	➢ Sensors
➢ Enhanced Surveillance Program	➢ INEEL
➢ Pit Manufacturing	➢ Technology Demonstrations/Deployments
➢ 94-1 Initiatives	➢ Brownfields
➢ Pu Disposition - MOX	➢ Modeling
➢ LLNL	➢ ORNL
➢ Pu Disposition - Immobilization	➢ Technology Demonstrations/Deployments
➢ Enhanced Surveillance Program	➢ ANL
➢ Technology Demonstrations/Deployments	➢ Pu Disposition
➢ Brownfields	➢ Brownfields
➢ PNNL	➢ Expedited Site Characterization
➢ ITP Chemistry Assistance	➢ Cone Penetrometer
➢ EM-50 Tanks Focus Area	➢ LBNL
➢ Pu Disposition	➢ Technology Demonstrations/Deployments
➢ Joint Proposals	➢ Modeling
➢ Sensors	➢ BNL
➢ Brownfields	➢ Technology Demonstrations/Deployments
➢ Modeling	➢ Modeling
➢ Technology Demonstrations/Deployments	➢ EML
➢ Ames Laboratory	➢ Joint US - Russia Environmental Modeling and Characterization Program
➢ Joint Proposals	➢ Hanford
➢ Small Sub-contracts	➢ Technology Deployment

Figure 10. National Laboratory Partnerships: 1996-1999.

2.2.5 Technology Transfer

The transfer of technology to private industry is an important part of the work done at SRTC. Technology transfer moves existing government-developed technologies into the private sector, helping businesses compete in the national and international marketplace. Through government/industry partnerships for the development of new technologies, SRTC also benefits from industry expertise in finding the best available solutions to mission challenges. SRTC ensures that it plays an active part in broad-based technology transfer activities by playing key leadership roles in the informal SRTC technology partnership working group.

Patent disclosures at SRTC number over 1,700 since 1989. In FY99, SRTC made 82 invention disclosures and 24 copyright disclosures. Eleven patents were awarded on 11 SRTC-developed technologies. Two non-exclusive commercial licenses were awarded. Forty-three government use notices were accomplished allowing SRTC-developed intellectual property to be used for government purposes. Ten single site licenses were awarded for software or handbooks.

Figure 11 summarizes the technology transfer activities at SRTC from 1995 to date. This past year an Intellectual Property Awareness campaign was conducted and a renewed emphasis was placed on copyrights and invention disclosures in all areas of work activity. Licensing via the internet was initiated. As a result, eight revenue-bearing licenses were signed and revenues doubled. Focusing on the DOE Complex and other government partnerships, 15 non-revenue-bearing government agreements were signed. The first license to include technical assistance from SRTC was awarded which will further develop the technology for the partner and enhance site core competence. The fees and royalties for WSRC-owned licenses go to WSRC, the fees and royalties for DOE-owned go to the U.S. Treasury.

	FY95	FY96	FY97	FY98	FY99	FY00 (projected)
Invention Disclosures	124	98	87	79	82	75
Patent Applications Filed	7	9	15	10	10	10
Patents Allowed	16	6	8	11	11	11
Copyrights	22	21	29	22	24	22
Licenses Issued	9	11	11	10	9	13
CRADAs Executed	15	4	2	0	1	--
License Fees & Royalties Received						
DOE Owned		$4.4K	$14.8K	$8.0K	$7.0K	$7.0K
WSRC Owned		$12.0K	$21.1K	$63.6K	$20.6K	$14.0K

Figure 11. SRTC's Technology Transfer Record.

2.2.6 Privatization

SRS has privatized or outsourced many of its functions to reduce outyear mortgages, allow for cost avoidance, and/or to contribute to the local economy. Some of these initiatives only peripherally affected operations at SRTC. There are several proposals under evaluation, such as the TNX operations, that could impact SRTC operations in the future. Recently, Booz-Allen and Hamilton, Inc. performed a study to determine the feasibility of privatizing SRTC. Their conclusions did not support privatization; however, numerous reengineering recommendations were provided. These recommendations were implemented by SRTC with resulting improvements in efficiency and cost effectiveness.

2.3 Status of Staffing

2.3.1 Demographics

SRTC currently has 750+ staff supporting its R&D efforts. The exempt staff, representing 73% of the workforce, are highly educated and skilled scientists and engineers, many with years of experience in supporting site missions. Close to 40% of the staff have advanced degrees. Figure 12 depicts both the skill mix and the educational levels of exempt employees.

SRTC participates in SRS's the Equal Employment Opportunity Special Emphasis Programs (SEP) to ensure a diverse workforce. For example, SRS Black Employment Program (BEP) is

one of the Special Emphasis Programs established to assist management in developing and implementing programs and activities that will enhance employment and development of employees and applicants at SRS.

2.3.2 Staffing Needs

SRTC has been in the process of hiring staff in its core competencies as a result of slightly increased funding, recent retirements, and other attrition. Since FY97, SRTC has hired 68 new scientists and engineers. Depending on attrition, and FY00 and outyear funding, SRTC will need to continue to add staff to ensure that it maintains highly qualified personnel in core competencies.

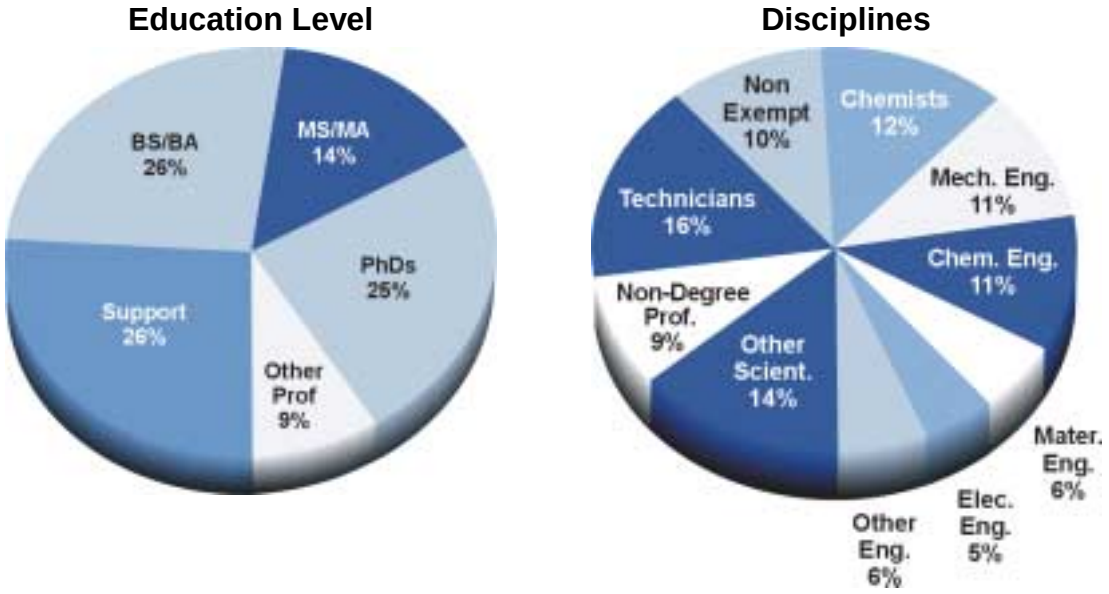


Figure 12. Staffing Profile for SRTC.

SRTC uses a staffing analysis process to determine its resource needs. Due to DOE funding instability, this analysis is currently performed 4-6 times per year. SRTC assesses staff needs based on scope, tasks, schedule, and Work for External Customer projections for the outyear. Staff profiles are compared to projected needs and positions matched accordingly. Resource gaps are identified and realignment and retraining is considered. Should any gaps still exist, a resource acquisition strategy is developed and implemented.

2.3.3 Other Workforce Issues

SRTC, as other organizations throughout DOE, is concerned over loss of qualified people having unique mission-related skills through retirement and attrition. Figure 13 shows the age distribution of exempt employees at SRTC. An analysis shows that over half of the technical staff considered to be core competency employees are eligible to retire in the next five years. It is becoming increasingly difficult to recruit highly qualified or even apprentice scientists in some of SRTC's areas of expertise such as actinide chemistry. To respond to this problem DOE-SR and SRTC have funded a tenured professor at Clemson University and will fund a series of fellowships for graduate students in the actinide area. In addition, DOE-SR funds three other professors in waste management and other environmental arenas in the South Carolina University system.

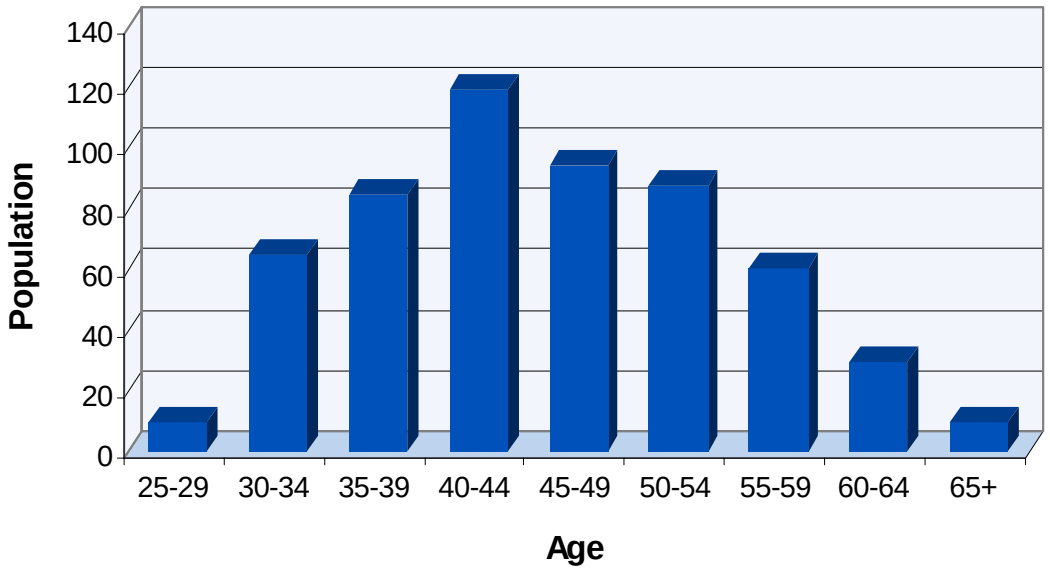


Figure 13. Age Distribution of SRTC Exempt Employees (FY99 data).

SRTC is pursuing other creative solutions to address these issues. This past year one of SRTC's objectives was to increase the visibility of the lab and gain recognition of its expertise. The goal was to increase the recognition of SRTC staff for contributions to the scientific community through national and international rewards and increase the stature through publications in peer reviewed journals. As a result of an increased emphasis, over 40 SRTC staff now hold offices in national organizations and over 26 articles were published in peer reviewed journals over the last performance period. In addition, SRTC established the Mini-Sabbatical Program to continue to encourage staff to publish. The result of such activities is an improvement in the lab's ability to attract and retain highly skilled technical staff.

2.4 Operations Oversight

The SRTC laboratory facilities have been in operation since the 1950's. Over the years, a number of infrastructure systems (facilities and equipment) have deteriorated and become obsolete and must be restored or replaced in the near future. These systems are critical to SRTC's ability to continue to support SRS's strategic goals and mission. A Life-Cycle Asset Management (LCAM) analysis was conducted that identifies the projects necessary to support DOE missions. It compares the cost of maintaining the existing facilities with the cost of building a new facility. The comprehensive infrastructure restoration plan to restore the capabilities of SRTC laboratory facilities, while reducing the laboratory's footprint, is documented in the following references:

- M-ESR-A-00012 Analysis of SRTC Infrastructure Alternatives, a Systems Engineering Approach, revision 0, dated June 22,1998
- TSD-TSED-99-XXXX Annual Review of the SRTC and CLAB LCAM Analysis, dated July, 1999.

SRTC receives its infrastructure funding directly from site funds. Infrastructure includes capital (analytical) equipment and infrastructure equipment. As such, SRTC is in competition with the

general infrastructure needs of the site as a whole, and safety items are appropriately funded first. With limited site funding for infrastructure needs, SRTC continues to experience funding levels far below what is needed to maintain current capabilities. Deferral of these projects has created a tremendous backlog that is now beyond the financial capabilities of the site's annual funding allocations.

2.4.1 Analytical Equipment

To be an effective research operation, SRTC must have up-to-date analytical equipment and instrumentation. Most of the analytical equipment and instrumentation has exceeded its design life. Obsolete equipment imposes safety hazards and increases the cost and time to prepare good samples. It becomes increasingly difficult to prepare accurate samples and ensure good failure analyses. Without new analytical equipment, safety issues will not be resolved in a timely manner without extensive workarounds, and support to the operating divisions will not be satisfactory.

Since SRTC competes with the general infrastructure needs of the site as a whole, procurement of analytical equipment and instrumentation is often deferred because the priorities are not as high as that for safety or regulatory required projects. Appendix C itemizes the equipment that is currently in the AOP infrastructure budget for FY00 and that which is unfunded for FY00. In addition, there is a list of items from the database sorted by outyears. In the forecast FY02 Infrastructure Restoration Line Item, it was initially proposed to include funding for equipment and instrumentation, in order to supplement the site's infrastructure budget to reduce the unfunded backlog.

2.4.2 Infrastructure and Facility Projects/Needs

SRTC is housed in over 635,000 square feet of general purpose, laboratory, and office space. Most of the unique radiological SRTC facilities date back to the 1950's and 1960's and require significant upgrades. Appendix D lists the various SRTC facilities and their respective ages. Deferred maintenance costs are steadily increasing because of age and deterioration in some of the facilities. Funds have not been available for general upgrades and modernization, and in some cases, laboratory capabilities have been sacrificed for operational safety. Safe and efficient operation of these aging systems is essential for SRS to continue to perform its missions. SRTC has proposed several line item upgrades to its infrastructure. One of these line items, Restoration of Technical Area Ventilation, has already been validated for FY01. However, under the current budget restraints, no funding is currently allocated in FY01 for that Line Item. The ventilation systems are the key safety systems used to protect both the public and facility worker from process events. SRTC ventilation systems directly support the Center's ability to provide full functional capabilities. Other line item needs identified in the FY02 outyear budget are as follows:

1) Restoration of Waste Collection and Transportation System
2) Restoration of Shielded Cells, 773-A
3) Reduction of Radiological Hazards in Technical Area
4) Independent Waste Handling Facility.

A recent external review recommended the development of a recovery plan for SRTC facilities; however, funding for these activities must become a priority item and separated from the infrastructure and facility funding for the rest of the site. Since SRS has experienced a shortage of infrastructure funds, SRTC has been successful in obtaining funds for only the very highest priority infrastructure safety and regulatory required projects. These include the recent projects to replace the Laboratory Roof, B and C-Wing Off Gas Exhaust System, Low Range Stack Monitors, and Shielded Cells HEPA Filter Housings.

2.4.3 Quality Assurance/Conduct of Research

Quality Assurance (QA) at SRTC reflects the overall site approach to ensuring quality support to its customers. QA at SRTC is an evolving process from NQA in the late 1980's and early 1990's, Total Quality in the mid-1990s to Integrated Safety Management System (ISMS) and Conduct of Research and Development today. QA is embedded in all of SRTC's processes, programs and procedures. It is aimed at:

- safety
- customer satisfaction
- credibility and validity of work.

The QA Department at SRTC acts as a guide in the interpretation and application of various regulation, laws, standards, and customer requirements. The Department administers a self-assessment program and represents SRTC to outside assessors and site customers. By conducting the oversight function required by regulation the QA Department ensures quality scientific and engineering support.

The elements of QA at SRTC are:

- self assessment – line involvement, performance based
- QAP 2-3 – grades QA involvement in research tasks
- Conduct of Research and Development
- Integrated Safety Management System
- regulatory component – ensures compliance.

The most recent addition to the QA tools at SRTC is the Conduct of Research and Development Manual. The purpose of the manual is to establish research philosophy and formalize the methodology for conducting work with the objective to achieve excellence in Research and Safety Performance. R&D conducted at SRTC or by SRTC personnel must meet several criteria. It shall be:

- performed safely, and within the established guidelines for personnel exposure and environmental releases
- high quality and produce results that are defensible to expert reviewers
- conducted economically and efficiently
- communicated effectively, meet the needs of customers and programs, and be well documented.

The manual provides standards for conducting R&D to meet demanding criteria. In some cases, such as conformance with safety and environmental requirements, specific guidelines and procedures have been established and references provided. Other aspects of research vary among programs and the guidance is, therefore, more general. In all cases, the responsibility for performing quality R&D resides with the scientist or engineer. The R&D Manual is gaining recognition in the DOE complex for incorporating the ISMS into R&D activities.

The objective of ISMS is to integrate safety considerations, along with R&D performance and infrastructure maintenance and improvement, into management and execution of work at all levels so the SRTC mission is accomplished while protecting the public, the workers, and the environment. Hence, all SRTC personnel give proper consideration to safety aspects at all stages of work.

SRTC has an exemplary safety record in the DOE complex. Latest statistics show the SRTC has the lowest injury and illness case rates among all DOE research contractors with greater than 1,000 employees (see Figure 14). SRTC employees have worked 3.5 years without a lost work injury. The trend for reported injuries has shown a marked and steady decline in the last 7 years (see Figure 15) as a result of SRTC's commitment to improving worker safety through innovative measures such as the R&D Manual and the implementation of ISMS.

2.4.4 Security

Since SRTC plays a pivotal role in stockpile stewardship, security is always a high priority. The Center is set in a limited area. The security program is a broad-based program with numerous mutually supportive elements, including armed guards, the challenge system, restricted access and a robust Operational Security (OPSEC) program. In 1999, SRTC's outside work portfolio was continuing to grow and SRTC staff decided to perform an OPSEC review of major external contracts. The purpose of this review was to identify:

- information produced and handled by SRTC employees that, if it fell into the hands of competitors, would significantly impact their ability to secure funding (i.e., Critically Sensitive Information)
- organizations that would benefit from accessing this information
- major vulnerabilities or pathways by which the sensitive information might be accessed
- risks to the business of loss of this information
- countermeasures currently in use to mitigate vulnerabilities
- additional countermeasures that could be implemented.

As a result of the review, guidelines were established for handling and marking of documents and Intellectual Property Awareness training was initiated. Based on the recommendations, an OPSEC Plan was modified. This plan is reviewed annually by the WSRC OPSEC Manager, revised as appropriate, and submitted to SRS for review and approval.

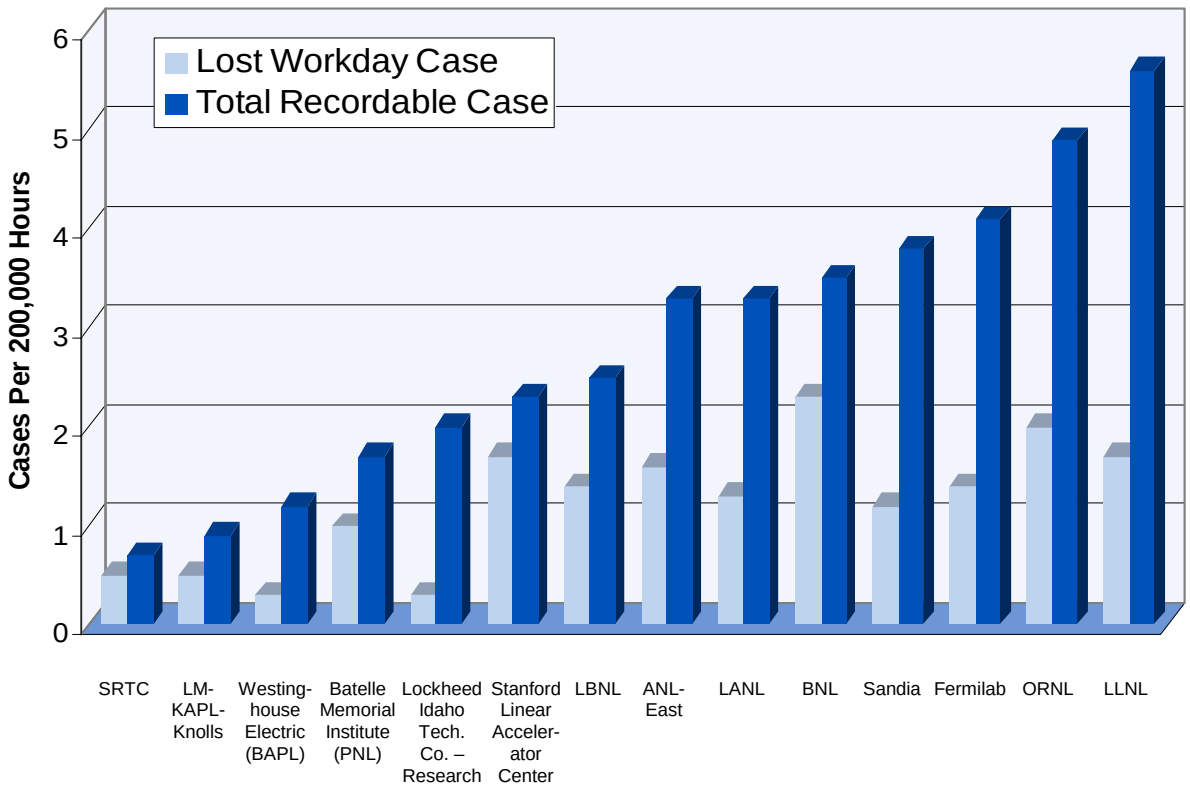


Figure 14. Injury and Illness Ranking of DOE Research Contractors (January - June 1998).

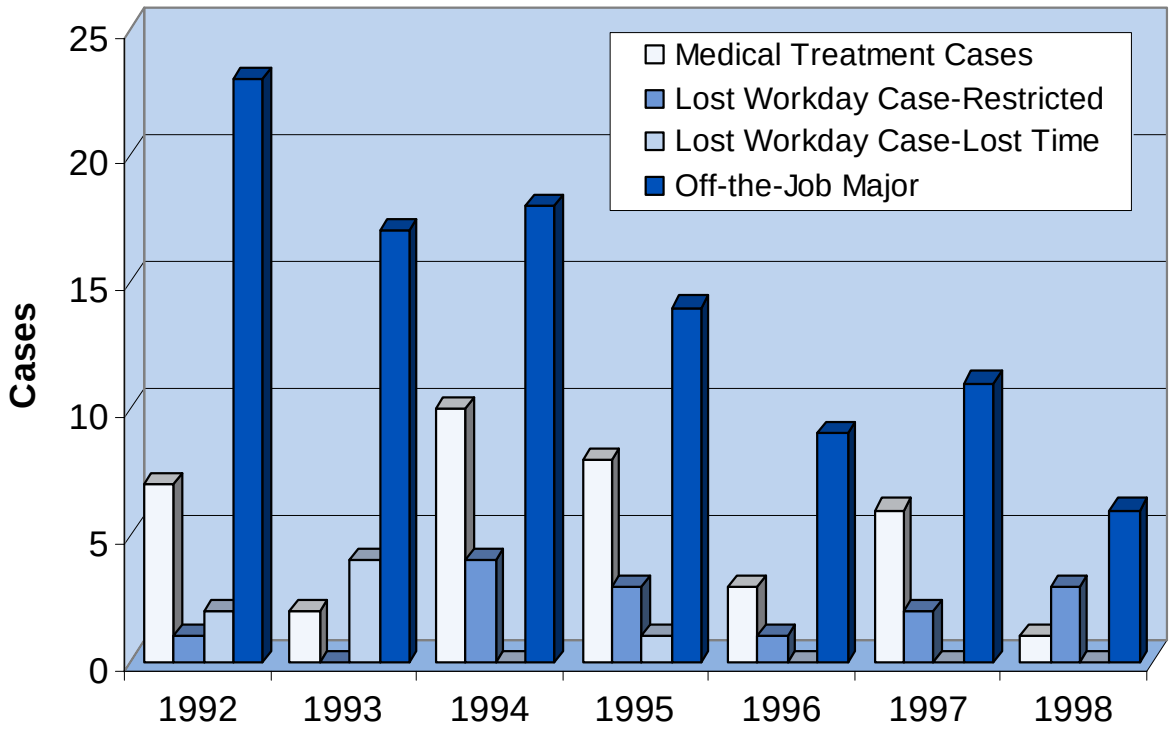


Figure 15. SRTC Injury Trend from 1992 to 1998.

2.4.5 Information Management

The Information Technology Department (ITD) supports SRTC's information management needs. ITD is responsible for developing (or acquiring and maintaining) core business and office systems and supports engineering and scientific applications as well. ITD operates the site data center, or Central Computer Facility (CCF), the site data network, and manages the site voice and video networks. ITD also manages centralized acquisition of IT components, the end user support function, and strategic IT planning and DOE customer interface for the site.

SRTC makes use of the centrally provided set of IT computing and communications utilities that are shared by all site customers. SRTC also fully funds the CRAY SV1.

To prepare for the Year 2000 (Y2K), SRTC documented over 1400 computers, instruments, and software packages as being Y2K compliant. This audit met the 3/31/99 Office of Management and Budget (OMB) milestone established for all government agencies. Systems were renovated or replaced as appropriate, and tested to verify compliance where necessary.

2.4.6 Community Relations/Communications

SRTC, through SRS, has a good working relationship with the surrounding communities and participates in community activities to promote that relationship. SRS Community outreach activities and business development activities within the surrounding area include:

- Economic Transition has assisted in attracting 21 new companies to the Central Savannah River Area (CSRA) through the marketing of the site's excess equipment. These 21 companies have created 880 new jobs and the projected job growth is 4150
- An extrusion press obtained from SRS is the heart of the EFCO plant operation. EFCO has increased employment to 450. In addition, MidAm, a supplier targeted by WSRC's cluster approach, opened a $1 million facility in nearby Williston
- WSRC provided assistance to local communities in response to emergencies:
  - Edgefield County – Tornado relief
  - Allendale County – Courthouse fire
  - Williston – Water system emergency
- Community Assistance coordinated a community reception and stakeholder roundtable for Secretary Richardson's visit to the CSRA. In addition, meetings with Secretary Peña were organized for his visit to the CSRA
- The Westinghouse Community Giving Program provided over $564K to organizations within the CSRA
- WSRC partnership sponsored a Habitat for Humanity Home for an Augusta family
- WSRC partnership partnered with News Channel 6 to bring Doppler Radar to the CSRA. Information from the radar is shared by SRTC weather center, Channel 6, and the Emergency Response agency in Richmond County
- Schools, both public and private, from Columbia and Richmond counties in Georgia and Aiken, Allendale, Barnwell and Orangeburg counties in South Carolina received $6,527,566 of surplus equipment through SRS's Math & Science Equipment Gift Program
- SRS School-to-Work program, which is a partnership between WSRC's Education Outreach Department, local school districts, and technical colleges, had 119 students

participating from both Georgia and South Carolina. In 1998, Richmond County, with six high school students, and Augusta Technical Institute, with five students, joined those schools partnering with the site

- A total of 143 research interns were placed in positions at SRS during FY98, the highest number in five years, with 43% female and 32% minorities
- The WSRC team received a 1998 State Board of Education Business Award for contributions to public education
- WSRC provided $49,500 through its Excellence-in-Teaching Mini-Grants Program, which provides grants to classroom teachers for innovative ideas to enhance elementary and middle school science and math curricula. Ninety-four projects were funded in 1998
- The hydrogen bus completed commercial demonstrations providing regular bus service as part of the Augusta Transit Department's fleet. The bus, a world first, is powered by an internal combustion engine fueled by hydrogen and is twice as efficient as a diesel engine. The bus has been delivered to the Weapons Test Site in Nevada for continued testing.

SRTC also works with the Citizens Advisory Board (CAB) which is composed of 25 individuals from South Carolina and Georgia. Chosen by an independent panel of citizens from approximately 250 applicants, the board members reflect the cultural diversity of the population affected by SRS. The members, who serve two- or three-year terms, represent all walks of life, including the business world, academia, local government, environmental and special interest groups, and the general public.

The Board provides advice and recommendations to the DOE, EPA Region IV, and the South Carolina Department of Health and Environmental Control on environmental remediation, waste management and related issues.

Also important to community relations is the use of site technologies, capabilities, and facilities to establish new jobs in the local region. SRS plays a vital role in the economy of the two-state region. As site employment declines in the post-Cold War era, other employment opportunities must be added to preserve the economic vitality of the region. SRTC is exploring opportunities to use the laboratory to strengthen and diversify the local region's economy.

3 Appendices

Appendix A. Strategic Plan
Appendix B. SRTC's Performance Based Incentives
Appendix C. SRTC Equipment Needs
Appendix D. SRTC Facilities

APPENDIX A
STRATEGIC PLAN

APPENDIX B
SRTC's PERFORMANCE BASED INCENTIVES

APPENDIX C
SRTC EQUIPMENT NEEDS

APPENDIX D
SRTC FACILITIES